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INFLUENCE OF SEED INOCULATION WITH PHOSPHOREIN AND LEVELS OF PHOSPHORUS FERTILIZATION ON GROWTH, MINERAL CONTENTS, SEEDLESS GREEN PODS YIELD AND YIELD OF SEEDS OF THREE SUGAR PEA CULTIVARS UNDER SANDY SOIL CONDITIONS

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ABSTRACT

Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture, Suez Canal University, Ismailia Governorate during the two successive seasons of 2001/2002 and 2002/2003. The aim of this study was to investigate the influence of seeds inoculation with phosphorein and phophorus fertilization levels (16, 24 and 32 kg P_2O_5 */fed*) on the vegetative growth parameters, mineral contents, yield of seedless green pods/ plant, total yield of green pods/ *fed.* number and weight of green seeds/pod and weight of 100 seeds in plants of three cultivars of sugar pea (sugar pearl, snow wind and sugar gem) under sandy soil conditions.

Data indicated that all vegetative growth parameters i.e. number of leaves/plant, plant height, shoot fresh and dry weights and leaves area of plants obtained from seeds inoculated with phosphorein were significantly higher than those of uninoculated ones.All the previous growth parameters increased with increasing the rates of applied phosphorus. Some differences were observed between the three cultivars in this respect.

N, P and K were higher in plants treated with phosphorein or with phosphorus than their control and the increments were corresponding with the increase in the rate of applied phosphorus. Best results were obtained from the combination of phosphorein and 32 kg P_2O_5 */fed.* Plants of snow wind cv. had higher N,P,K than the other two cvs.

Yield chracteristics such as number of seedless green pods/plant, pods weight ,length and diameter, yield of pods/ plant and total yield/ *fed.* significantly increased with phosphorein and with increasing the rate of applied phosphorus as well as with combination of phosphorein and the highest rate of P. Number and weight of seeds/pod and weight of 100 green seeds followed a similar trend and the snow wind cv. gave the best recorded parameters.

The obtained results revealed that under sandy soil conditions, the snow wind cv treated with phosphorein before sowing and fertilized with 32 kg P_2O_5/ *fed* is the recommended cv for producing the highest yield with good quality.

INTRODUCTION

Pea (*Pisum sativum* L.) is one the most popular legumes all over the world as well as in Egypt. It is an important winter crop for local consumption and export. Recently the Egyptian agricultural policy focused great attention on the exportable crops such as sugar pea by introducing new cultivars and investigating the most suitable agricultural practices for producing the highest yield with the best quality of green pods.

Phosphorus, like nitrogen, is extremely important as a structural part of many compounds, notably nucleic acids, phospholipids, coenzymes NAD and

NADP, ATP and other high energy compounds (Bidwell, 1979). It plays a fundamental role in a very large number of enzymic reactions that depend on phosphorylation. It is also a constituent of the cell nucleus and is essential for cell division and the development of meristematic tissues (Russell, 1973). Moreover, phosphorus is a ubiquitous and essential element in the energy transfer processes; it is needed in the formation of fat, in transformation of starch to sugar, in fruiting and flowering and in fact in every phase of the plant's vital process. (Tisdale and Nelson, 1975).

The native P content in Egyptian soils is adequate, but it is highly immobile and easily fixed in the soil, due to the relatively high content of $CaCO_3$, low content of organic matter and being slightly alkaline (Hamissa *et al.*, 1991).

Biofertilizers containing phosphate dissolving bacteria are used to increase P availability in the soil by secreting organic acids such as formic, acetic, propionic, lactic, glycolic, fumaric and succinic acids. These acids lower the pH and bring about the dissolution of bound forms of phosphate. Some of the hydroxy acids may chelate with calcium and iron resulting in effective solubilization and utilization of phosphate (Subba Roa, 1984).

The aim of the present study is to investigate the effect of phosphorein and different levels of phosphorus fertilizer on the growth, nutritional status, yield and chracteristics of green pods, and number and weight of seeds/ pod.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Farm of the Faculty of Agriculture, Suez Canal University, Ismailia Governorate during the two successive seasons of 2001/2002 and 2002/2003. The aim of this study was to investigate the influence of seeds inoculation with phosphorein and phophorus fertilization levels (16, 24 and 32 kg P_2O_5 */fed*) on the vegetative growth parameters, mineral contents, yield of seedless green pods/ plant, total yield of green pods/ *fed* , number and weight of seeds/ pod and weight of 100 seeds in plants of three cultivars of sugar pea (sugar pearl, snow wind and sugar gem) under sandy soil conditions.

The physical and chemical properties of the experimental soil were 94.86 and 95.23 sand, 3.26 and 3.12 silt, 1.88 and 1.65 clay, 0.94 and 0.88 organic matter, pH 8.01 and 8.06 (sandy soil in texture), total N (g/kg) 0.14 and 0.17, P (g/kg) 5.56 and 5.67, K (meq/l) 0.54 and 0.58, $CaCO_3$ (%) 0.71 and 0.74 in the first and second seasons, respectively.

The experimental design during both seasons of the study was split - split plot in randomized blocks with three replicates. The main plot was assigned phosphorein treatments whereas the three phosphorus levels (16, 24 and 32 kg P_2O_5/*fed.*) were randomly allocated in the sub-plot and the three cultivars (sugar pearl, snow wind and sugar gem) were randomly distributed in the sub- sub plot. The sub-sub plot area was 14.4 m^2, consisting of 6 ridges, each ridge 4m long and 0.6m wide.

For soil preparation, farmyard manure was applied at 30 m^3/ *fed* and covered with 10 cm sand and half of N and K in addition to two thirds of P_2O_5 were added. The other one third of P_2O_5 was added two weeks after sowing, other fertlizers and all other agricultural practices were applied as recommended by the Ministry of Agriculture for the production of sugar pea plants in sandy soils. Plants received (40 kg N *fed.*) as ammonium sulphate, (75 kg K_2O /*fed*) as potassium sulphate and (16, 24 and 32 kg P_2O_5/*fed*) as calcium superphosphate. After soil preparation the inoculated and uninoculated seeds of the three cultivars were sown at 25th and 23rd of October for the first and second seasons, respectively.

Nine plants from each treatment were harvested before the formation of seeds in the pods to measure vegetative growth, chemical contents and seedless green pods yield parameters. Other plants were left to determine the green seeds parameters and the following data were recorded:

A-Vegetative growth parameters

1 -Stem length (cm).
2 -Number of leaves/ plant.
3 -Leaves area/plant (cm^2) was calculated according to the following equation:

$$\text{Leaves area / plant} = \frac{\text{Fresh weight of leaves / plant x Area of disks}}{\text{Fresh weight of disks}}$$

4 -Shoot fresh weight (gm).
5 -Shoot dry weight (gm) was determined after oven drying at 70 °C for 72 hours.

B-Chemical contents

1-Total nitrogen (% of dry wt.) was measured as described by A.O.A.C. (1975).
2 -Phosphorus (% of dry wt.) according to Jackson (1967).
3 -Potassium (% of dry wt.) according to Jackson (1967).

C-Yield and its components

Seedless green pods were harvested from each treatment before the formation of seeds to measure the parameters of green pods,and others were left until the green seeds were formed to record the seeds characteristics as follows:

1-Number of green pods/ plant.
2-Pod length (cm).
3-Pod diameter (cm).
4-Average weight of pod (gm).
5-Yield of seedless green pods/plant.(gm).
6-Total yield of seedless green pods/ *fed.*(ton).
7-Number of seeds/pod.
8-Weight of seeds/pod (gm).
9-Weight of 100 green seeds (gm).

Statistical analysis. The obtained data were subjected to statistical analysis according to Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

1-Vegetative growth.

1.1-Effect of phosphorein.

Results in Table (1) indicate that all vegetative growth parameters (number of leaves/ plant, plant height,shoot fresh weight, shoot dry weight as well as leaves area/ plant) of the plants obtained from seeds inoculated with phosphorein were significantly higher than those of untreated ones. The enhancing effect may be due to that phosphorein contains active bacteria which is capable of transforming the tri-calcium phosphate to mono- calcium phosphate, leading to an increase in the amount of phosphorus absorbed by the roots (Ashour,1998). Moreover, Suba Roa (1984) stated that phosphate dissolving bacteria possess the ability to transform insoluble phosphates in the soil into soluble form by secreting organic acids which lower the pH of the soil and bring about the dissolution of bound forms of phosphate and in turn stimulate the vegetative growth. These results were in agreement with those found by Hauka *et al.*(1996) on pea, Abo El-Nour *et al.*(1996) ; Radwan (1997) on faba bean, El-Shamma (2000) on dry bean, Abdalla (2002) on faba bean, Abdo (2003) on mung bean and Dawa *et al.*(2003) on pea.

1.2-Effect of phosphorus levels.

Data in Table (1) show that vegetative growth parameters significantly increased with increasing the rates of applied phosphorus. The percentages of increments of leaves area were 10.78 %, 18.17 % and 9.67 %, 16.66 % as a result of using 24 and 32 kg P_2O_5/ *fed.* compared with 16 kg/ *fed.* in the second season, respectively. Shoot dry weight also showed 22.53 % , 39.52 % and 21.76 %, 30.53 % in the first and second seasons, respectively. The promotiing effect of phosphorus on growth parameters could be attributed to the fundamental role of phosphorus in a large number of enzymic reactions that depend on phosphorylation. It is also a constituent of the cell nucleus and is essential for cell division and the development of merstimatic tissues (Russel, 1973). Phosphorus is also essential in the energy transfer processes, in plants suffering from P deficiency, a marked reduction in leaf expansion, leaf surface area (Fredeen *et al.*, 1989) and number of leaves (Lynch *et al.*, 1991) is the most striking effects. The obtained results were in accordance with findings of Abdalla (2002) on faba bean and Dawa *et al.* (2003) on pea.

1.3-Effect of cultivars.

Data in Table (1) show that vegetative growth differed among cultivars. Number of leaves/ plant was the highest with sugar pearl cv. and the differences between this cv. and the other two cvs. were significant. On the other hand, the differences between snow wind and sugar gem in this regard were not significant.

Plant height and shoot dry weight were higher in snow wind and sugar gem with significant differences compared with those of sugar pearl, but the difference between the former two cvs was not significant. Shoot fresh weight and leaves area were the highest in snow wind followed by sugar gem then sugar pearl. These results may be attributed to some genetic differences between the cultivars. Differences among cultivars were also found by Amer *et al.*(1992) and Radwan (1997) on faba bean.

Table (1): Effect of phosphorein, levels of phosphorus fertilizer on number of leaves / plant, plant height, shoot fresh and dry weights leaves area / plant , of three sugar pea cultivars grown in sandy soil during 2001/ 2002 and 2002/ 2003 seasons.

Characters / Treatments	No. of leaves	Plant height (cm)	Shoot fr.wt. (gm)	Shoot dry wt. (gm)	Leaves area/plant (cm^2)	No. of leaves	Plant height (cm)	Shoot fr.wt. (gm)	Shoot dry wt (gm)	Leaves area/ plant ($cm^{2)}$
	2001/ 2002					2002/ 2003				
Phosphorein										
With	16.86a	42.54a	27.35a	3.26a	360.71a	17.69a	45.22a	28.53a	3.40a	380.80a
without	14.80b	39.00b	24.02b	2.85b	332.85b	16.05b	41.17b	24.88b	2.92b	359.06b
P. levels kg P_2O_5/*fed.*										
16	14.08c	36.44c	21.66c	2.53c	316.26c	15.10c	38.51c	22.75c	2.62b	340.09c
24	15.79	41.63b	26.10b	3.10b	350.35b	16.82b	43.88b	27.07b	3.19a	372.98b
32	17.62a	44.21a	29.34a	3.53a	373.74a	18.69a	46.65a	30.29a	3.42a	396.74a
Cultivars										
Sugar pearl	16.70a	39.31b	24.86c	2.85c	335.93c	17.75a	42.03b	25.73c	2.92c	356.94c
Snow wind	15.36b	41.73a	26.56a	3.33a	363.42a	16.35b	43.75a	27.41a	3.47a	381.50a
Sugar gem	15.43b	41.27a	25.68b	2.98b	341.00b	16.50b	43.78a	26.97b	3.10b	371.36b

1.4-Effect of interaction.

The interaction effect of different treatments on the vegetative growth parameters is shown in Table (2). Data show that inoculation with phosphorein and application of phosphorus fertilizer increased all parameters of the treated plants. The increments were corresponding to the increase in the level of applied phosphorus. This was evident in the three cvs in the two seasons of study. The highest leaves number was obtained from sugar pearl plants which were inoculated with phosphorein and received the highest level of P. The highest values of plant height were obtained from inoculated plants of snow wind and sugar gem cvs with the highest rate of P. fertilizer. Regarding the shoot fresh and dry weights, as well as leaves area, snow wind cv. showed the highest values with phosphorein and 32 kg P_2O_5/ *fed.* Abo El-Nour *et al.*(1996) found that the combination of P. fertilizer and phosphorein promoted shoot dry weight and number of leaves of faba bean plants. Similar conclusions were found by Abdalla (2002) on faba bean, Abdo (2002) on mung bean and Dawa *et al.* (2003) on pea.

2.-Mineral contents.

2.1- Effect of phosphorein.

Data in Table (3) show that plants of phosphorein treatments had significantly higher N,P and K contents than those of untreated ones. This was true in the two seasons.The stimulating effect of phosphorein could be imputed to that phosphorein contains P dissolving bacteria which increase the available form of P and increase the absorbing capacity of roots which in turn increase the N,P and K contents in the shoots. Similar conclusions were obtained by Hauka *et al.* (1996) on pea, El-Shamma (2000) on dry bean and Dawa *et al.*(2003) on pea.

2.2- Effect of phosphorus levels.

Data in Table (3) indicate that nitrogen, phosphorus and potassium contents in the shoots increased with increasing the level of applied phosphorus fertilizer in the two seasons. The increase of N,P and K in the shoots could be attributed to the increase of the absorpition effeciency of the roots by P. These results coincided with those of Arisha (1993) and Dawa *etal.* (2003) on pea.

2.3- Effect of cultivars.

Data presented in Table (3) illustrate that nitrogen content was significantly higher in the shoots of snow wind cv. than in the other two cvs., which showed no significant differences in this regard in both seasons of the study.

Table (2): Interaction effect of phosphorein, levels of phosphorus fertilizer on number of leaves / plant, plant height, shoot fresh and dry weights, leaves area / plant, of three sugar pea cultivars grown in sandy soil during 2001/2002 and 2002/2003 seasons.

Characters / Treatments		No. of leaves	Plant height (cm)	Shoot fr.wt. (gm)	Shoot dry wt. (gm)	Leaves area/ plant (cm^2)	No. of leaves	Plant height (cm)	Shoot fr.wt. (gm)	Shoo dry wt (gm)	Leaves area / plant ($cm^{2)}$
		2001/2002					2002/2003				
With phosphorein											
Cultivar	P.levels										
Sugar pearl	16	15.14	38.09	23.78	2.68	310.92	15.95	40.77	24.70	2.80	348.72
	24	17.00	41.44	27.23	3.14	344.82	18.05	44.09	28.05	3.21	372.62
	32	20.39	43.12	29.81	3.48	388.82	21.20	48.11	30.59	3.56	406.10
Snow wind	16	14.26	39.30	24.43	3.05	327.74	15.33	41.26	25.69	3.16	349.32
	24	16.13	45.20	29.43	3.67	386.82	16.92	47.15	30.12	3.72	395.16
	32	18.24	46.83	31.81	3.98	409.14	18.89	49.12	32.19	4.03	421.15
Sugar gem	16	15.22	38.18	22.27	2.54	340.29	16.09	40.27	24.10	2.63	354.19
	24	17.34	44.24	27.38	3.14	364.82	17.82	47.15	28.90	3.21	383.91
	32	18.00	46.33	30.93	3.63	373.00	18.94	49.10	32.43	3.74	396.09
Without phos.											
Sugar pearl	16	13.56	33.50	20.31	2.26	288.82	14.42	35.42	21.18	2.33	301.72
	24	16.01	38.50	22.88	2.59	323.56	17.53	40.17	23.67	2.62	342.31
	32	18.11	41.11	25.73	2.96	358.64	19.37	43.63	26.23	2.98	370.18
Snow wind	16	13.21	35.11	19.70	2.36	319.50	14.19	37.19	20.42	2.42	335.47
	24	14.54	40.20	25.61	3.21	364.68	15.72	41.94	26.35	3.30	385.17
	32	15.79	43.70	28.88	3.69	372.60	17.03	46.01	29.71	3.75	402.74
Sugar gem	16	13.11	34.48	19.98	2.28	310.29	14.61	36.17	20.41	2.39	351.12
	24	13.72	40.20	24.75	2.85	317.37	14.87	42.75	25.32	2.97	358.71
	32	15.20	44.19	29.38	3.42	340.21	16.70	47.23	30.62	3.51	384.16
F test		NS	NS	***	**	NS	NS	NS	***	*	NS

Phosphorus content was also higher in the shoots of snow wind cv. The differences between this cv and the other two cvs were significant in the first season only while in the second one, the differences were only significant with sugar pearl cv. Potassium content was the highest in the shoots of sugar gem cv followed by snow wind then sugar pearl cv. This was evident in the two seasons.

Table (3): Effect of phosphorein, levels of phophorus fertilizer on the contents of nitrogen, phosphorus and potassium as percentage of dry weight of three sugar pea cultivars grown in sandy soil during 2001/ 2002 and 2002/2003 seasons.

Characters	N%	P%	K%	N%	P%	K%
Treatments	2001/ 2002			2002/ 2003		
Phosphorein						
with	3.530 a	0.466 a	2.30 a	3.361	0.485 a	2.28 a
without	3.449 b	0.428 b	2.12 b	3.202	0.429 b	2.03 b
P. levels kg P_2O_5/fed.						
16	3.401 c	0.406 c	2.00 c	3.144 c	0.420 c	1.94 c
24	3.491 b	0.452 b	2.27 b	3.288 b	0.465 b	2.22 b
32	3.578 a	0.484 a	2.36 a	3.413 a	0.487 a	2.32 a
Cultivars						
Sugar pearl	3.487 b	0.438 b	2.15 c	3.255 b	0.444 b	2.08 c
Snow wind	3.551 a	0.452 a	2.23 b	3.343 a	0.469 a	2.12 b
Sugar gem	3.431 b	0.440 b	2.26 a	3.248 b	0.459 a	2.27 a

2.4- Effect of interaction.

Data in Table (4) show that N, P and K contents were the highest in the shoots of snow wind cv plants which were treated with phosphorein and received the highest level of P. fertilizer. This was evident in the two seasons, except K in the second season which appeared the highest in sugar pearl cv. plants. The lowest values of N, P and K were in the shoots of plants untreated with phosphorein and received the lowest rate of phosphorus fertilizer.

3-Yield and its components of green pods.

3.1-Effect of phosphorein.

Data in Table (5) show that inoculation with phosphorein significantly increased all yield parameters (No. of pods/plant, pod length, pod diameter, average pod weight, yield of green pods/ plant and total yield of green pods/*fed*). The increments in average pod weight were 9.33% and 10.10 % in the first and second seasons, respectively, compared with the untreated plants. Phosphorein treatments increased yield / plant by 18.66 % and 14.96 % as well as yield / fed by 11.58 % and 14.77 % over their control in the first and second seasons, respectively. The increase in yield parameters by phosphorein is due to the ability of active bacteria to transform the insoluble form of phosphate to soluble form and increasing its availability to the plants and this in turn increases plant growth and yield. Results coincided with the findings of Abo El-Nour *et al.*(1996) and Dawa *et al.*(2003) on pea.

Table (4): Interaction effect of phosphorein , levels of phosphorus fertilizer on the contents of nitrogen phosphorus, and potassium as percentage of dry weight of three sugar pea cultivars grown in sandy soil during 2001/ 2002 and 2002/2003 seasons.

Characters / Treatments		N%	P%	K%	N%	P%	K%
		2001/ 2002			2002/ 2003		
With phosphorein							
cultivars	P. levels						
Sugar pearl	16	3.428	0.411	1.94	3.211	0.423	1.96
	24	3.516	0.472	2.36	3.364	0.481	2.46
	32	3.613	0.495	2.43	3.411	0.493	2.49
Snow wind	16	3.511	0.443	2.23	3.402	0.451	2.12
	24	3.603	0.491	2.36	3.487	0.511	2.24
	32	3.668	0.513	2.46	3.507	0.528	2.32
Sugar gem	16	3.411	0.419	2.12	3.156	0.456	2.12
	24	3.482	0.468	2.39	3.276	0.503	2.36
	32	3.542	0.480	2.41	3.434	0.518	2.44
Without phosphorein							
Sugar pearl	16	3.372	0.366	1.88	3.049	0.391	1.72
	24	3.426	0.418	2.08	3.122	0.412	1.91
	32	3.552	0.467	2.23	3.368	0.462	1.96
Snow wind	16	3.372	0.406	1.82	3.032	0.422	1.72
	24	3.521	0.438	2.17	3.267	0.446	2.02
	32	3.631	0.488	2.31	3.361	0.451	2.28
Sugar gem	16	3.291	0.388	2.02	3.011	0.377	1.98
	24	3.397	0.422	2.26	3.212	0.434	2.32
	32	3.462	0.462	2.31	3.349	0.468	2.40
F test		NS	NS	**	NS	NS	**

3.2- Effect of phosphorus levels.

Data in Table (5) illustrate that the applied phosphorus rates increased all the yield parameters and the increments were corresponding with the increase of applied P level. Pod weight increased by 4.14 % ; 9.33 % and by 6.31 %; 11.65 % as a result of using 24 and 32 kg P_2O_5/ *fed* . compared with 16 kg/ *fed.*, in the first and second seasons, respectively. Yield/ plant increased by 12.21 % ; 22.28 % and 12.88 %; 25.00% in plants fertilized with 24 and 32 kg P_2O_5/ fed compared with those had 16 kg/ *fed.*, in the two seasons, respectively. The same treatments increased total yield/ fed. by 10.90 % ; 23.08 % and by 11.83 % ; 23.67 %.The effect of phosphorus on the yield parameters may be due to the beneficial role of P in energy transfer and utilization on the other metabolic processes which reflect on increasing plant growth and yield. It is also a result of the role of P in the essential processes such as photosynthesis, carbohydrate metabolism, synthesis of protein and fatty acids and other processes which depend on the action of coenzymes NAD and NADP (Bidwell, 1979). These results were held good with those obtained by Arisha (1993), Metwally (1995), Ali (2000) all on pea, Abdalla (2002) on faba bean, Abdo (2003) on mung bean and Dawa *et al* (2003) on pea.

Table (5): Effect of phosphorein, levels of phosphorus fertilizer on number of pods / plant, pod length , pod diameter, average weight of green pod, yield of green pods/ plant and total yield of green pods (ton/ feddan) of three sugar pea cultivars grown in sandy soil during 2001/ 2002 and 2002/2003 seasons.

Characters / Treatments	No. of pods/ plant	Pod length (cm)	Pod diameter (cm).	Average pod wt (gm)	Yield/ plant (gm)	Yield/ feddan (ton)	No. of pods/ plant	Pod length (cm)	Pod diameter (cm).	Average pod wt . (gm)	Yield/ plant (gm)	Yield/ feddan (ton)
	2001/2002						2002/2003					
phosphorein												
with	10.52 a	8.42 a	1.57 a	2.11a	22.00 a	1.83 a	11.22	8.47 a	1.60 a	2.29 a	25.44 a	2.02 a
without	9.72 b	7.56 b	1.50 b	1.93 b	18.54 b	1.64 b	10.73	7.62 b	1.51 b	2.08 b	21.13 b	1.76 b
P. levels kg P_2O_5/*fed*												
16	9.55 c	7.71 c	1.46 a	1.93 c	18.18 c	1.56 c	10.36 c	7.76 c	1.47 b	2.06 c	21.12 c	1.69 c
24	10.21 b	7.98 b	1.55 a	2.01 b	20.40 b	1.72 b	11.00 b	8.04 b	1.58 a	2.19 b	23.84 b	1.89 b
32	10.60a	8.27 a	1.60 a	2.11 a	22.23 a	1.92 a	11.58 a	8.33 a	1.62 a	2.30 a	26.40 a	2.09 a
Cultivars												
Sugar pearl	10.82 a	7.69 b	1.23 b	1.67 c	18.09 c	1.61 b	11.94 a	7.75 b	1.25 b	1.82 c	21.84 c	1.74 c
Snow wind	9.35 c	8.88 a	2.12 a	2.51 a	23.50 a	1.98 a	10.06 c	8.92 a	2.14 a	2.72 a	27.37 a	2.18 a
Sugar gem	10.18 b	7.40 c	1.26 b	1.88 b	19.22 b	1.62 b	10.93 b	7.46 c	1.28 b	2.03 b	22.15 b	1.76 b

3.3- Effect of cultivars.

Results of Table (5) indicate that sugar pearl plants gave the highest number of pods followed by those of sugar gem cv then snow wind cv. on the other hand snow wind cv gave the highest values of pod length, pod diameter, average weight of pod, yield/ plant and total yield/ *fed.* data, followed by sugar gem and then came sugar pearl cv. This was evident in the two seasons. These results might be due to account of the differences in genetical make up of the varieties. Amer *et al* (1992), El-Khawaga and Zeiton (1992) and Radwan (1997) came to similar conclusion.

3.4- Effect of interaction.

Data presented in Table (6) show that number of pods/ plant was highest in sugar pearl plants treated with phosphorein and fertilized with 32 kg P_2O_5/*fed.*. The lowest number of pods/ plant observed in uninoculated snow wind plants which received 16 kg P_2O_5/ *fed.*However, snow wind plants with phosphorein and 32 kg P_2O_5/*fed* gave the highest values of pods weight, yield/ plant and yield/ fed. El-Khawaga and Zeiton (1992) found significant differences in response of faba bean cultivars to different levels of phosphorus.

4-Number and weight of seeds/ pod and weight of 100 seeds.

4.1- Effect of phosphorein.

Results of Table (7) reveal that number and weight of seeds/ pod and weight of 100 seeds increased as a result of inoculation with phosphorein. The increments were not significant for seeds number and significant for the weight of seeds. The significant effect of phosphorein could be due to its role in transforming the fixed form of P and increasing the uptake of phosphorus which helps in increasing the weight of seeds. Results are in coincidance with those found by El-Kalla *et al.*(1997) and Abdalla (2002) on faba bean , Abdo (2003) on mung bean and Dawa *et al.* (2003) on pea.

4.2- Effect of phosphorus levels.

Data in the same Table (7) show that number and weight of seeds/ pod significantly increased with increasing the levels of applied phosphorus. The weight of 100 seeds showed a similar trend but the differences were not significant between the medium and higher levels of applied phosphorus. The increments in the seed weight may be due to the significant effect of P on vegetative growth and the uptake of nutrients which in turn increased the stored nutrients in the seeds. Results are in accordance with Abdo (2003) on mung bean and Dawa *et al.* (2003) on pea.

4.3- Effect of cultivars.

Data in Table (7) declared that number and weight of seeds/ pod were significantly higher in snow wind cv. than the other two cvs. followed by sugar gem then sugar pearl cv. The differences between the latter two cvs. were not significant. The weight of 100 seeds showed a similar trend but the differences between the three cultivars were significant.

Table (6): Interaction effect of phosphorein, levels of phosphorus fertilizer on number of pods/ plant, pod length, pod diameter, average weight of pods plant, yield of green pods / plant and total yield of green pods/ feddan of three sugar pea cultivars grown in sandy soil during 2001/ 2002 a2002/ 2003 seasons.

Characters / Treatments		No. of pods/plant	Pod length (cm)	Pod diameter (cm)	Average pod wt. (gm)	Yield / plant (gm)	Yield/ *fed* (ton).	No. of pods/plant	Pod length (cm)	Pod diameter (cm)	Average pod wt (gm)	Yield / plant (gm)	Yield/*fed*. (ton)
		2001/ 2002						2002/ 2003					
With phosphorein													
cultivars	P.evels												
Sugar pearl	16	10.41	7.74	1.23	1.69	17.59	1.27	11.55	7.79	1.25	1.78	20.56	1.64
	24	10.91	7.91	1.26	1.72	18.76	1.57	12.26	7.96	1.28	1.90	23.29	1.83
	32	11.29	8.20	1.30	1.82	20.55	1.78	12.97	8.27	1.32	2.00	25.94	2.06
Snow wind	16	8.63	9.21	1.98	2.52	21.76	1.71	9.85	9.28	2.01	2.73	26.89	2.15
	24	10.18	9.58	2.23	2.63	26.77	1.89	10.24	9.63	2.25	2.88	29.49	2.34
	32	10.53	9.83	2.30	2.68	28.22	2.06	10.60	9.86	2.33	2.96	31.38	2.48
Sugar gem	16	10.34	7.50	1.23	1.92	19.85	1.35	10.39	7.55	1.25	2.03	21.09	1.69
	24	11.02	7.68	1.29	1.94	21.37	1.45	11.19	7.72	1.31	2.12	23.72	1.86
	32	11.36	8.11	1.33	2.04	23.17	1.71	11.95	8.15	1.37	2.23	26.65	2.13
Without phos.													
Sugar pearl	16	10.13	7.17	1.15	1.39	14.08	1.53	11.02	7.22	1.17	1.52	16.75	1.34
	24	10.94	7.51	1.18	1.63	17.83	1.67	11.81	7.57	1.21	1.78	21.02	1.69
	32	11.23	7.60	1.23	1.76	19.76	1.86	12.05	7.70	1.26	1.95	23.50	1.87
Snow wind	16	8.60	7.89	1.94	2.34	20.12	1.98	9.25	7.93	1.93	2.48	22.94	1.84
	24	8.77	8.21	2.11	2.42	21.23	2.05	9.92	8.26	2.14	2.59	25.69	2.05
	32	9.42	8.54	2.17	2.43	22.89	2.17	10.54	8.58	2.18	2.64	27.83	2.21
Sugar gem	16	9.18	6.72	1.20	1.71	15.70	1.57	10.11	6.78	1.22	1.83	18.50	1.48
	24	9.46	7.00	1.25	1.74	16.46	1.73	10.56	7.12	1.27	1.88	19.85	1.57
	32	9.42	7.36	1.28	1.93	18.79	1.92	11.32	7.40	1.26	2.04	23.09	1.81
F test		*	NS	NS	***	***	*	*	NS	NS	***	***	**

Table (7): Effect of phosphorein, levels of phophorus fertilizer on number of seeds/pod, weight of seeds/ pod and weight of 100 seeds of three sugar pea cultivars grown in sandy soil during 2001/ 2002and 2002/ 2003 seasons.

Characters / Treatments	No.of seeds/pod	Wt of seeds/ pod (gm)	Wt. of 100 seeds (gm)	No.of seeds/ pod	Wt. of seeds/ pod (gm)	Wt of 100 seeds (gm)
	2001/ 2002			2002/ 2003		
Phosphorein						
With	8.22 a	3.18 a	38.21 a	8.99 a	3.39 a	41.32 a
Without	8.04 a	3.03 b	36.70 b	8.78 a	3.24 b	39.51 b
P. levels Kg P_2O_5/*fed.*						
16	7.86 c	2.96 c	36.16 b	8.57 b	3.15 c	38.98 b
24	8.12 b	3.12 b	37.60 a	8.83 b	3.35 b	40.47 a
32	8.41 a	3.24 a	38.60 a	9.11 a	3.49 a	41.83 a
Cultivars						
Sugar pearl	7.67 b	2.93 b	37.65 b	8.48 b	3.17 b	40.98 b
Snow wind	8.87 a	3.51 a	38.62 a	9.50 a	3.73 a	41.66 a
Sugar gem	7.84 b	2.88 b	36.10 c	8.52 b	3.04 b	38.65 c

4.4- Effect of interaction.

Results of Table (8) show that the highest number and weight of seeds/ pod and weight of 100 seeds were found in snow wind cv when treated with phosphorein and with the highest rate of phosphorus. The lowest values were obtained from sugar gem plants untreated with phosphorein and fertilized with 16 kg P_2O_5/*fed.*

Table (8): Interaction effect of phosphorein, levels of phophorus fertilizer on number of seeds / pod, weight of seeds/ pod and weight of 100 seeds of three sugar pea cultivars grown in sandy soil during 2001/2002 and 2002/ 2003 seasons.

Characters / Treatments		No.of seeds/pod	Wt of seeds/ pod (gm)	Wt. of 100 seeds (gm)	No.of seeds/ pod	Wt. of seeds/ pod (gm)	Wt of 100 seeds (gm)
		2001/ 2002			2002/ 2003		
With phosphorei n							
Cultivars	P.levels						
Sugar pearl	16	7.55	2.92	37.23	8.32	3.19	40.33
	24	7.70	2.98	38.69	8.46	3.27	42.15
	32	7.82	3.05	39.81	8.61	3.39	43.19
Snow wind	16	8.81	3.44	38.17	9.44	3.64	41.35
	24	8.86	3.61	39.41	9.53	3.87	42.10
	32	9.25	3.82	40.07	9.92	3.95	44.01
Sugar gem	16	7.63	2.76	35.49	8.26	2.90	38.15
	24	7.85	2.94	36.92	8.47	3.10	39.72
	32	8.48	3.09	38.11	9.11	3.22	41.12
Without phos.							
Sugar pearl	16	7.41	2.74	35.41	8.15	2.92	38.15
	24	7.69	2.91	36.72	8.37	3.10	40.11
	32	7.86	2.97	38.00	8.97	3.17	41.92
Snow wind	16	8.42	3.23	36.87	9.12	3.44	39.75
	24	8.79	3.41	38.09	9.63	3.68	41.03
	32	9.11	3.56	38.89	9.34	3.81	41.73
Sugar gem	16	7.36	2.69	33.79	8.10	2.81	36.17
	24	7.80	2.88	35.56	8.52	3.08	37.72
	32	7.92	2.93	36.74	8.71	3.19	39.04
F test		NS	NS	NS	NS	NS	NS

This was noticed in the two seasons. Moreover, in each cultivar, the best results were obtained from the combination between phosphorein and 32 kg P_2O_5/*fed.* the combind effect of phosphorein and P on the yield of seeds was also obtained by Abo El-Nour *et al.*, (1996) and El- Kalla *et al.* (1999) on faba bean and Dawa *et al.* (2003) on pea.

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تأثير معاملة البذور بالفوسفور ين و معدلات التسميد الفوسفاتي على النمو و المحصول الأخضر و المحتوى المعدني لثلاثة أصناف من البسلة السكرية تحت ظروف الأراضي الرملية

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أجريت تجربتان حقليتان في مزرعة كلية الزراعة جامعة قناة السويس بالإسماعيلية خلال موسمي ٢٠٠١/٢٠٠٢و ٢٠٠٢/٢٠٠٣ بغرض دراسة تأثير معاملةبذور البسلة السكرية قبل الزراعة بالفوسفور ين و التسميد الفوسفاتي بمعدل ١٦و ٢٤ و٣٢ كجم فو٢ا٥ للفدان و ذلك على النمو والمحتوي المعدني و المحصول الأخضر لثلاثة أصناف من البسلة السكرية (شوجر بيرل و سنو وند و شوجر جيم) النامية في أرض رملية.

أظهرت الدراسة أن النباتات الناتجة من البذور المعاملة بالفوسفورين تفوقت في قياسات نموها الخضري (عدد الأوراق، ارتفاع النبات، كل من الوزن الطازج و الجاف للعرش و مساحة الأوراق للنبات) عن مثيلتها الناتجة من البذور التي لم تعامل بالفوسفورين. كما أن قيم هذه القياسات زادت مع زيادة معدل السماد الفوسفاتي.

زاد محتوي الأوراق من كل من النيتروجين والفوسفور و البوتاسيوم نتيجة للمعاملة بالفوسفورين و أيضا مع زيادة معدل التسميد الفوسفاتي و كانت أفضل النتائج المتحصل عليها من النباتات المعاملة بالفوسفورين و المسمدة بالمستوي الأعلى ممن السماد الفوسفاتي وتفوق الصنف سنو وند علي الصنفين الآخرين في محتوي أوراقه من هذه العناصر.

زاد محصول القرون الخضراء قبل تكوين البذور بها زيادة معنوية في النباتات الناتجة من البذور المعاملة بالفوسفورين و كذلك في النباتات التي سمدت بالفوسفور وكانت الزيادة في المحصول متمشية مع الزيادة في معدل السماد المضاف. وكانت صفات المحصول (عدد القرون الخضراء للنبات، وزن القرن و طوله و عرضه ومحصول القرون للنبات) أفضل في النباتات المعاملة بالفوسفورين و المسمدة بالمستويات الأعلى من السماد الفوسفاتي. و لقد أظهر محصول البذور و صفاته اتجاها مماثلا لمحصول القرون الخضراء.

أوضحت النتائج المتحصل عليها أنه تحت ظروف الأراضي الرملية فان الصنف سنو وند المعامل بالفوسفورين و المسمد بمعدل ٣٢ كجم فو٢ا٥/ فدان يعتبر أفضل الأصناف الثلاثة من حيث كمية المحصول وصفاته.